[100 Yen Gadget Disassembly] (54) Extra: Tamagotchi Uni

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¥300

*This article is based on an article published in the September 2023 issue of Monthly I/O, with additional content and corrections.
Since it has been significantly expanded, it is now available for a fee, but you can read the full article for free.

Bandai has released the Tamagotchi Uni, which is equipped with the ESP32, a chip often used in electronic crafts, and can be connected to the internet for play. This time, as a special edition, we will take it apart.

Packaging and product appearance

View Package

The Tamagotchi Uni will be released on July 15, 2023, with a standard retail price of 8,250 yen (tax included), making it a slightly more expensive product in the Tamagotchi series.

Package Appearance

The bottom of the package has the technical conformity mark (attached with a sticker) and the lithium-ion polymer battery recycling mark.

Technical conformity and recycling mark on the bottom of the package

When I searched for the number, I found that the Technical Conformity Certificate had been obtained not for the finished product, but for the built-in wireless module (ESP32-S1-WROOM-1).

Information on obtaining technical certification (excerpt)

## Package contents and appearance of the main unit

The package contains the device itself, an instruction manual, and a USB charging cable (USB-A to Type-C). The instruction manual is only a single sheet, and a proper one must be downloaded from the official website.
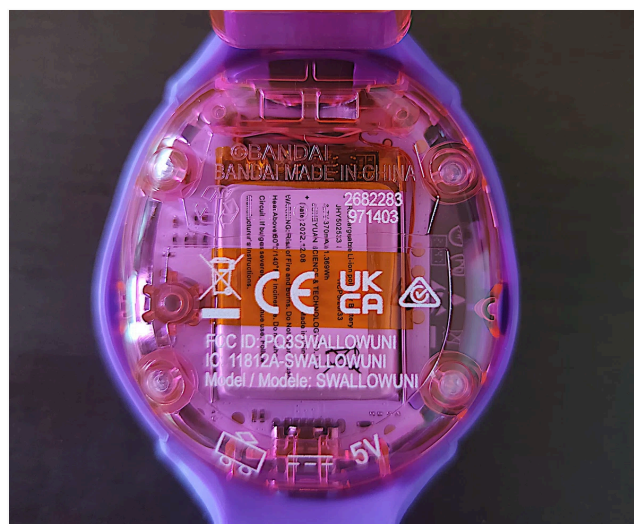
Package Contents

The main unit has a belt attached, which can be easily removed.
There is a USB Type-C port for charging on the bottom of the main unit. By the way, I tried connecting it to a PC using this port, but it was not recognized as a USB device.
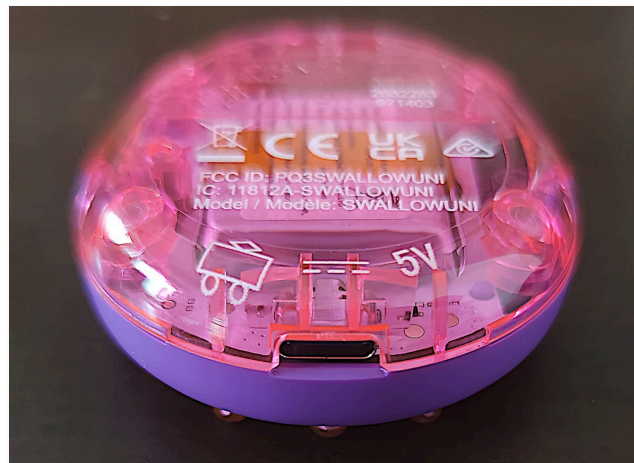
Charging port on the bottom of the unit

The back of the device is translucent, and the built-in LiPo battery (370mAh) is visible. The back also displays the FCC ID (US technical standard), with the model name "SWALLOWUNI". When I checked the FCC report (https://fcc.report/FCC-ID/PQ3SWALLOWUNI) using this ID, I found that "BANDAI (SHENZHEN) CO., LTD." has obtained FCC certification. The device does not display the technical certification mark.

FCC Report

Disassembly of the main unit

Unpacking the unit

The cover of the screw part on the back of the main unit can be removed by inserting a precision screwdriver, etc., and removing the screws that secure it.
The LiPo battery is attached to the board with double-sided tape, and the antenna of the wireless module can be seen on the right side of the board. The speaker is on the top of the main unit.
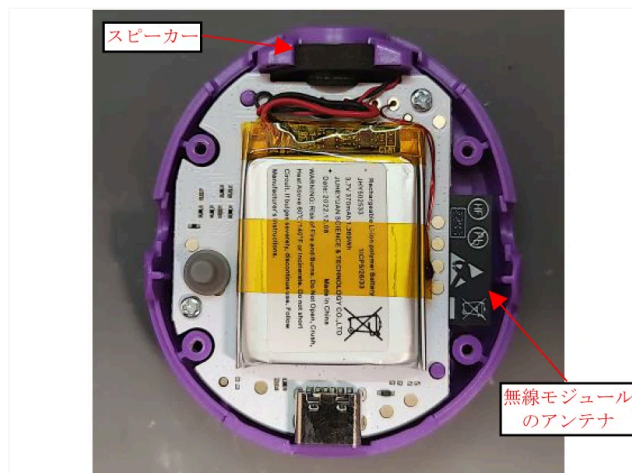
Back cover removed

A thermistor for monitoring temperature is fixed next to the LiPo battery with yellow polyimide film tape.
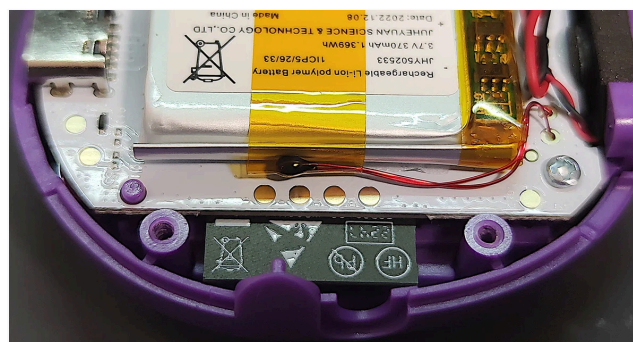
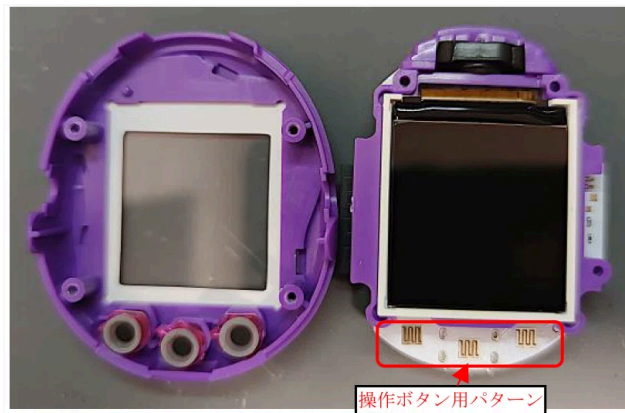Remove the cover on the front of the unit (the LCD screen side). The LCD panel is attached to a plastic molded part with double-sided tape, and this molded part is fixed to the main board with screws. The operation buttons are designed to short out the pattern on the printed board with the conductive rubber of the button part.

With the front cover removed

The LCD panel and main board are connected with a connector (11 pins), and below the panel is the wireless module (ESP32-S3-WROOM-1). The wireless module also does not have the technical conformity mark, so if you are using it in Japan, you will need to keep the package.
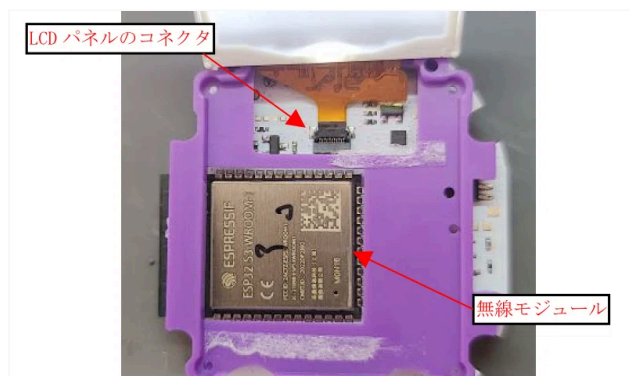
LCD panel removed

Main board configuration

Installed parts

The main board is a double-sided board made of glass epoxy (FR-4).
The semiconductor components are mounted on the surface, and the main components are the wireless module (main processor), audio DAC and audio amplifier, LiPo charger IC, 3.3V LDO for powering the wireless microcontroller, and load switch.
The LiPo battery, thermistor for temperature monitoring, and speaker are soldered to the main board with lead wires.
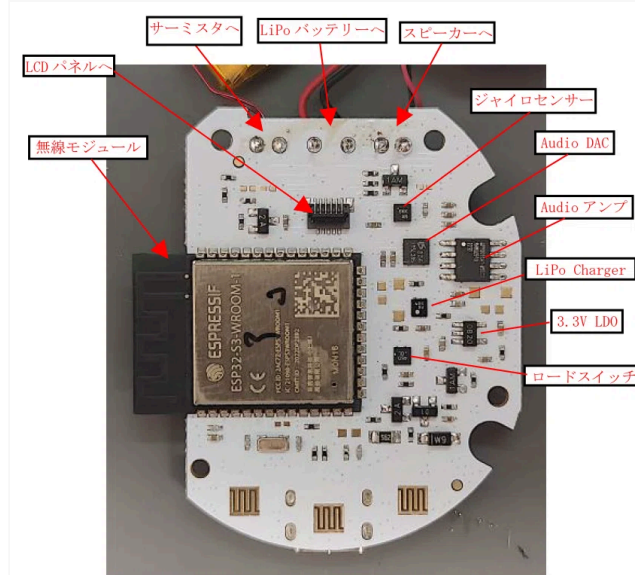
Main board (front)

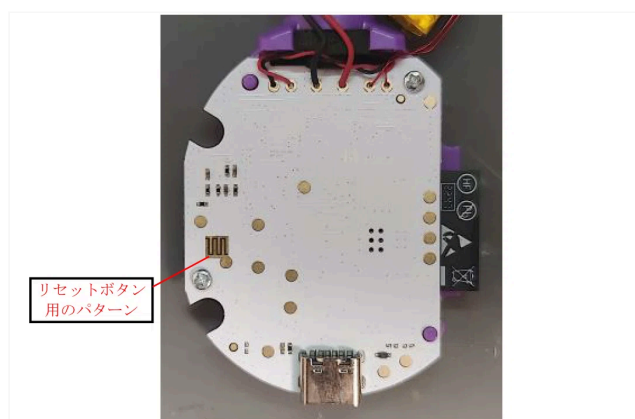The Type-C connector is mounted on the back. There is a pattern for the reset button and several test lands. The Type-C connector is a 6-pin type for charging only, and only the VBUS/GND and CC lines for power are connected.

The CC lines are connected to pull-down resistors on the front, so you can charge it without any problems with a PD-compatible charger.

Main board (back side)

The test land on the back of the wireless microcontroller module is for debugging purposes and outputs signals for initiating Download Boot to UART and flash.
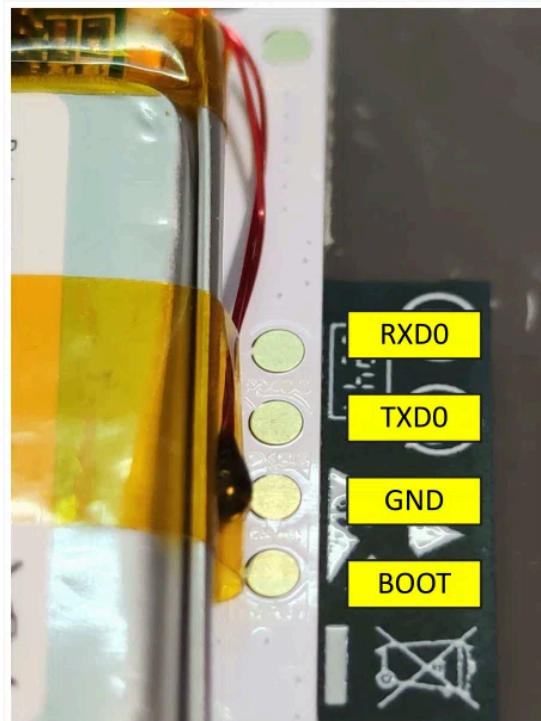
Debugging Patterns

Printed circuit board pattern

The white resist on the board made it difficult to see the pattern, so I took photos with different lighting angles and then combined them. I got the impression that the pattern on the printed circuit board was very neat.
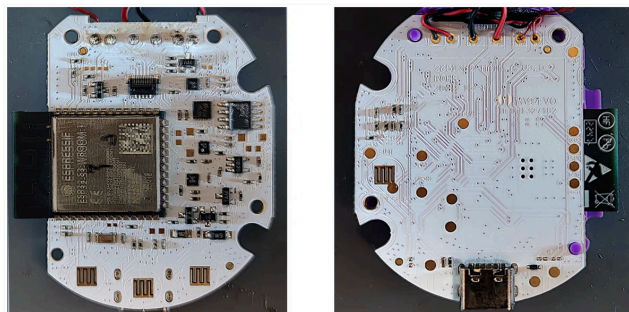
Printed circuit board pattern

Main parts specifications

Wireless module ESP32-S3-WROOM-1

Wireless Module

The wireless module is the "ESP32-S3-WROOM-1" , which is a modularized version of the ESP32-S3, an SoC with built-in wireless functionality manufactured by Espressif Systems (Shanghai) Co., Ltd. (https://www.espressif.com/), and peripheral memory . It is a dual-core Xtensa 32-bit CPU LX7 (operating at up to 240MHz), and has 384KB ROM, 512KB SRAM, and 16MB SPI flash. Supported wireless standards are 802.11b/g/n (2.4GHz band only) and Bluetooth LE.

The data sheet is available below.

https://www.espressif.com/sites/default/files/documentation/esp32-s3-wroom-1_wroom-1u_datasheet_en.pdf

Figure 1: ESP32-S3-WROOM-1 Block Diagram

Block Diagram (Excerpt from Datasheet)

Audio DAC ES8156

Audio DAC

The audio DAC is the "ES8156" from Everest Semiconductor (http://www.everest-semi.com/) . It supports two stereo channels, left and right, but this product only uses one channel. The package is QFN-20, and it supports a maximum sample rate of 96kHz/24bit with I2S input and has a built-in 7-band equalizer.
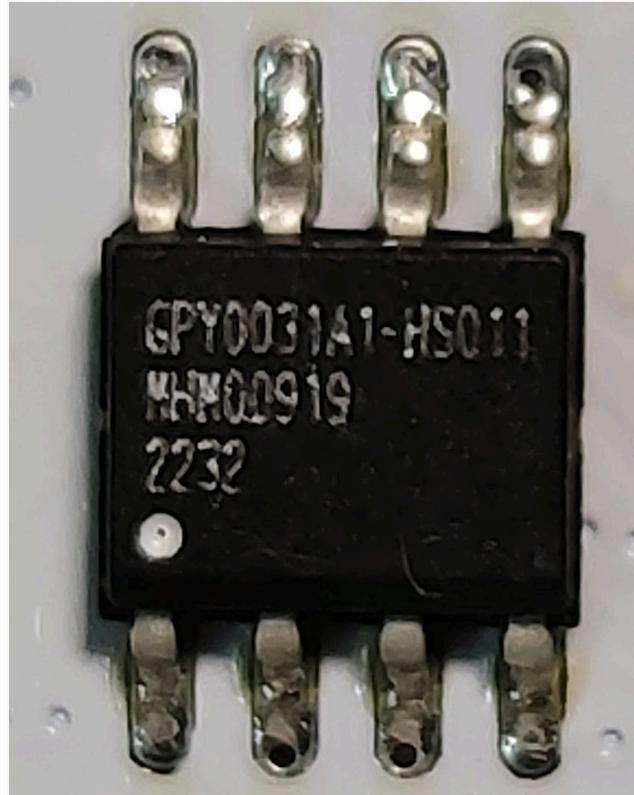
The data sheet is available below.

http://www.everest-semi.com/pdf/ES8156%20PB.pdf
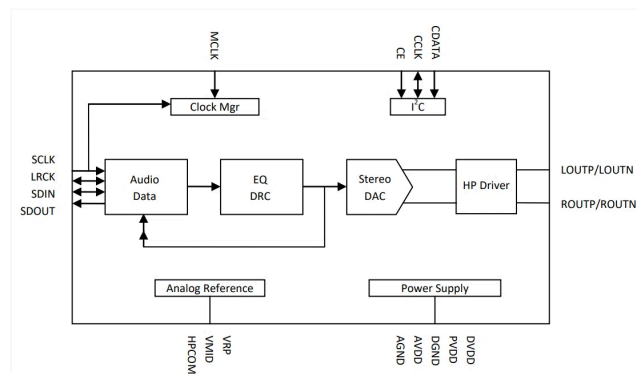
Block Diagram (Excerpt from Datasheet)

Audio power amplifier GPY0031A1-HS011
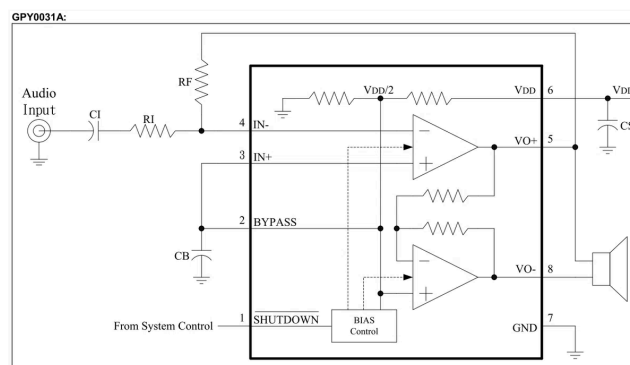
Audio Power Amplifier

The audio power amplifier is the "GPY0031A1-HS011" from Generalplus Technology Inc. (https://www.generalplus.com/) . It is a high-performance IC with a maximum output of 2W and low distortion (THD+N=0.15%@630mW).

The data sheet is available below.

https://www.generalplus.com/pLVfLN11915SVpfSNnormal_download

Block Diagram (Excerpt from Datasheet)

Gyro sensor Model number unknown

Gyro sensor

I searched for the gyro sensor based on the "6KK AN" marking, but I couldn't find it. On Tamagotchi Uni, you can play games that use the gyro function by going to "Game Center" -> "Let's Dance♪".

"Let's Dance" is fun to play by attaching it to your arm and moving it to the rhythm.
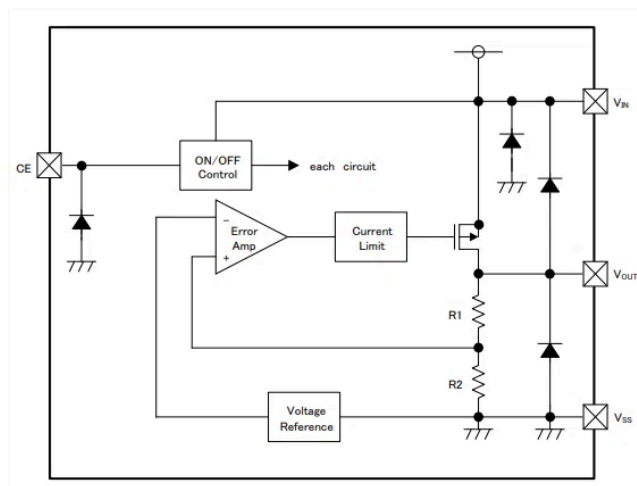
3.3V LDO XC6210B332MR

3.3V LDO

The part marked "0B20" is a 3.3V LDO **"XC6210B332MR"** from Torex Semiconductor of Japan (https://www.torexsemi.com/) . It has a small package (SOT-25) but a large output current of up to 800mA, and is used to power wireless modules.
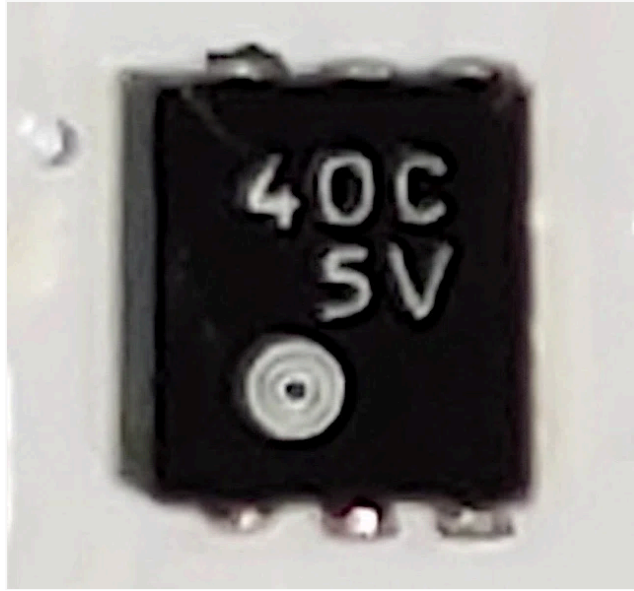
The data sheet is available below.

https://product.torexsemi.com/system/files/series/xc6210.pdf

Block Diagram (Excerpt from Datasheet)

LiPo Charger XC6804A4E14R-G

LiPo Charger

The part marked "40C" is also manufactured by Torex Semiconductor, a 1-cell Li-ion battery charger IC, the **"XC6804A4E14R-G** .

" It has low current consumption (100uA typ.), a battery temperature detection function using a thermistor, and a CC charging current setting function using an external resistor.

The data sheet is available below.

https://product.torexsemi.com/system/files/series/xc6804-j.pdf
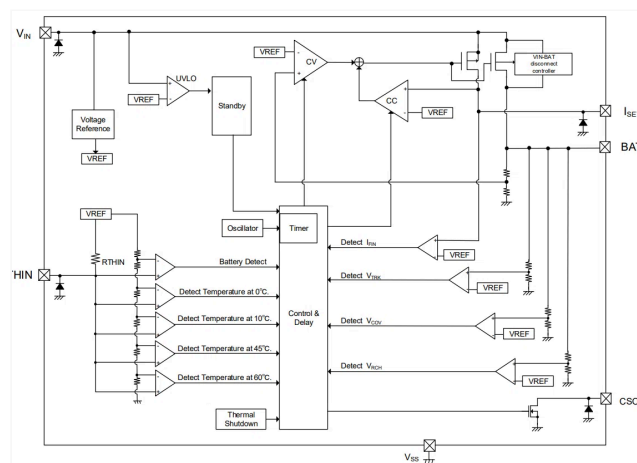
Block Diagram (Excerpt from Datasheet)

Load Switch XC6194B3NNER-G

Load Switch

The part marked "460" is also manufactured by Torex Semiconductor and is the intelligent load switch **"XC6194B3NNER-G"** .

It can be turned on with a push button and shut down with an external signal to the STDN terminal. It has a maximum output current of 1A and a leakage current of 1nA (TYP.) during shutdown, making it extremely low power.
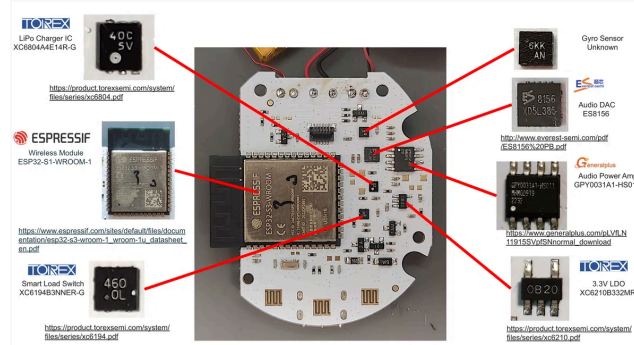
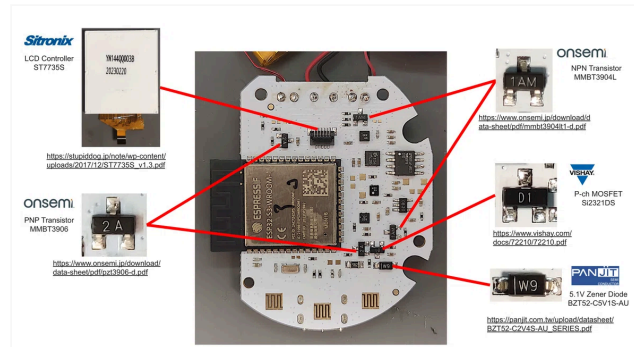The data sheet is available below.

https://product.torexsemi.com/system/files/series/xc6194-j.pdf
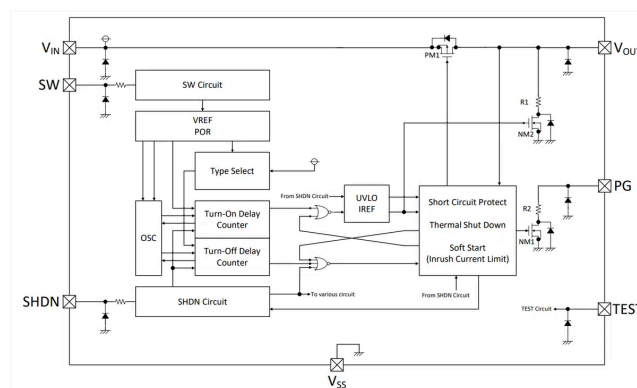
Block Diagram (Excerpt from Datasheet)

Summary of main parts

We have summarized the layout of the main parts, including the results of our investigation.

Layout of main components (IC)

Layout of major components (other semiconductor components)

summary

The ESP32 series is a microcontroller that is very commonly used in electronic gadgets, and it has been adopted by a major manufacturer's products.It is a very carefully crafted design, and I got the impression that it is a product with an excellent balance between cost and functionality.

- Easy to disassemble and assemble due to its simple structure
- Reduce costs by implementing patterns for operation buttons
- Use high-performance components to achieve power saving, which is a product benefit

I actually tried using it, and even after five days of being fully charged, the battery didn't run out and it still worked normally. Since development games like this one are often left unattended, I think the long battery life is a very important point.

This time, I only analyzed the structure and parts used, but if I have the opportunity, I would like to analyze it in more detail.